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(71)(72) Applicants and Inventors: CAHILL, Robert, Charles [AU/AU]; VICKERY, Lyn [AU/AU]; 495 Kalamunda Road, High Wycombe, W.A. 6057 (AU).

(74) Common Representative: CAHILL, Robert, Charles; 495 Kalamunda Road, High Wycombe, W.A. 6057 (AU).

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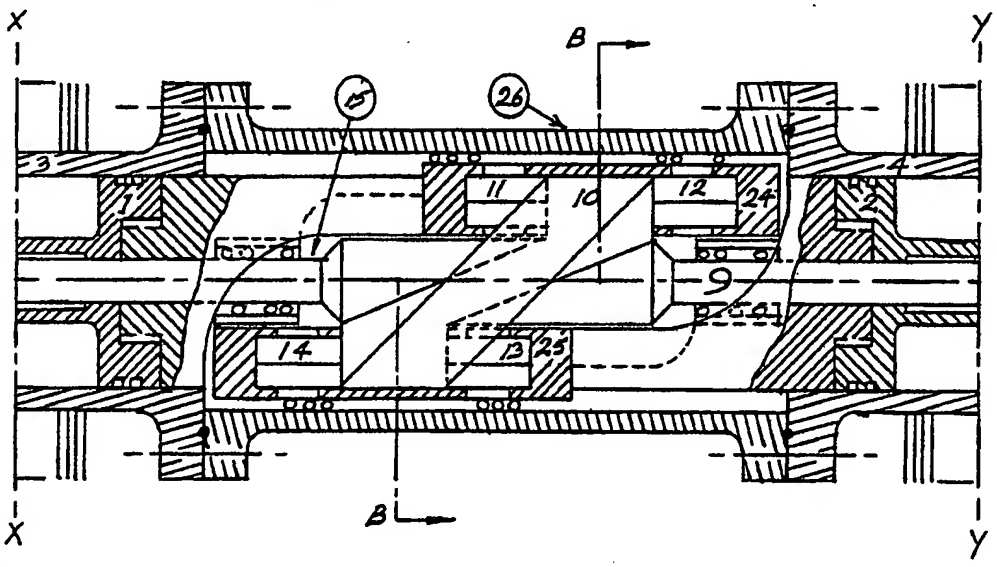
(54) Title: AXIAL SHAFT PISTON ENGINE



(57) Abstract

A mechanism which may be used as an internal combustion engine, positive displacement piston pump or compressor in which the output shaft (9) is co-axial with the pistons (1, 2), said shaft (9) passing longitudinally through the centre of the pistons (1, 2), and in which the reciprocating movement of the pistons (1, 2) is transformed into rotational movement of the shaft (9), and vice versa, by means of a cylinder cam (10) mounted on the shaft (9) and rollers (11, 12, 13, 14) attached to torque resisting extensions (24, 25) of the pistons (1, 2). As the pistons (1, 2) are forced along respective opposed cylinders (3, 4) by gas pressure, the rollers (11, 12, 13, 14) mounted in extensions (24, 25) act on the cylinder cam (10) and produce a torque on the cam (10) and thus rotation of the shaft (9). Conversely, in the pumping configuration, a torque applied to shaft (9) by external means causes pistons (1, 2) to reciprocate in the cylinders (3, 4) and with the aid of suitable valving enables the mechanism to function as a pump.

AXIAL SHAFT PISTON ENGINE

This invention relates to a mechanism which may be used as an internal combusion piston engine or positive displacement piston pump or compressor in which the output shaft is co-axial with the pistons and in which the reciprocating movement of the pistons is transformed into rotational movement of the shaft (and vice versa) by means of one or more cylinder cams mounted on the shaft and acting with rollers attached to the pistons.

Conventional piston engines and pumps utilize a piston(s) - connecting rod - crankshaft arrangement in which the direction of the piston movement is at right angles to the axis of crankshaft rotation. This results in complexity in terms of parts, high reciprocating mass, side thrust on pistons, complexity of manufacture of crankshaft and crankcase assemblies, comparative large physical size per unit capacity and difficulty in balancing reciprocating masses, particularly in single cylinder units.

The objects of this invention are to reduce physical size for a given capacity, simplify the manufacture of the major structural parts, reduce the number of parts, simplify the balancing of reciprocating masses, and increase mechanical efficiency.

The objects of this invention are achieved by arranging the pistons and shaft co-axially, with the shaft running through the centre of the pistons.

The pistons and cylinders are arranged such that the pistons move inwards and outwards in their cylinders concurrently under the effects of the gas pressures in the combustion chambers and act, via rollers mounted in a yoke attached to extensions of the pistons, on the cylinder cam which is mounted on, and forms part of, the axial output shaft. This in turn produces torque in the shaft.

Conversely, in the pump configuration, torque applied to the shaft rotates the cylinder cam which acts on the rollers and causes the pistons to reciprocate in their respective cylinders.

FEATURES

The features that distinguish this mechanism from other piston engines are as follows;

1/ The use of a cylinder cam instead of a crankshaft.
2/ Output shaft co-axial with piston movement.

OPERATION

The following details the operation of the engine.

FIGURES 1A, 1B & 1C show the mechanism as an internal combustion engine (see also schematic diagrams FIG 2 & 3).

Two pistons (1) & (2) (FIG 1B), reciprocate in cylinders (3) & (4). Each of which is enclosed at its end by an end cap (5) &(6) (FIGS 1A & 1C) which together with the top end of the piston (1) & (2), forms the combustion chambers (7) & (8).

A shaft (9) runs axially through the centres of the end caps and the pistons and carries a specially shaped cylinder cam (10) at its centre.

The cam (10) is straddled by double rollers (11)(12) & (14)(13) (FIG 1B) which are mounted in yokes (24) & (25) attached to an extension of each piston (1) & (2), thus causing the pistons to reciprocate longtitudinally as the shaft (9) and cam (10) rotate.

FIGURES 2 & 3 are schematic representations of the mechanism.
The fuel air mixture enters, via a carburettor and valve (16) FIG 2, into the space (15) formed by the pistons around the cam as the pistons move outward. Movement of the pistons inward due to the further rotation of the cam results in the valve (16) closing and the fuel air mixtures starts to compress in space (15). When the pistons approach their inner most position, the induction port

(17) is uncovered by the pistons and the pressurised charge transfers from the space (15), via the transfer ports (18) into the combustion chambers (7) & (8).

Further rotation of the shaft and cam causes the pistons to again move outward, covering the induction ports (17) and the exhaust ports (19) and compressing the fuel air charge in the combustion chambers (7) & (8).

At the appropriate time, the spark plug (20) ignites the fuel thus causing a pressure build up in the combustion chambers (7) & (8) and the pistons to be forced inwards. This imparts a force to the cam (10) via the rollers (11) & (13) and causes the cam to rotate and impart torgue to the shaft (9).

Further inward motion of the pistons uncovers the exhaust ports (19) thus allowing the burn't gases to escape ready for the induction of a fresh charge of fuel and air. As the shaft rotates further, the inlet ports (17) open and the cycle repeats.

Torque reaction on the pistons (1) & (2) is opposed by flat linear roller bearings (27) acting between the piston yokes (24) & (25) FIGURE 4 forming part of the piston extension, and the centre section engine casing, (26) FIG 4.

The foregoing describes the operation when the mechanism is used as a power producing device.

CYLINDER CAM VARIATIONS

Whilst the foregoing description relates to drawings which show a two lobe cam (10), giving one inwards and one outwards piston stroke per revolution of the shaft (9), a multi lobe cam may be used to give more strokes per shaft revolution.

FIG 6., shows a four lobe cylinder cam which will give two inward and two outward strokes of the pistons (1) & (2) per revolution when mounted on the shaft (9) in place of the two lobe cam - FIG 5. This will provide two power pulses per revolution of the shaft, hence increasing torque, when used in the

internal combustion engine configuration or two pumping strokes per revolution when used in the pump configuration.

MECHANISM AS A PUMP DEVICE

The operation when used as a pump is as follows.

FIGURE 7 depicts one end i.e. one pumping chamber for simplicity.
When the shaft (9) is turned by external means, the cylinder cam (10) rotates and causes the psitons (1) & (2), by means of the rollers (12) & (14), to move inwards and draw fluid (gaseous or liquid) through the valve (21) into the annular space (7). Further rotation of the shaft (9) causes the pistons (1) & (2) by means of the rollers (11) & (13) to move inwards and force the fluid from the space (7) out of the valve (22).

A further application of this configuration would have one chamber used as an internal combustion power producing piston engine (as in FIG 3) and the other chamber used as a pump.

CLAIMS

The claims defining the invention are as follows;

1/ An engine having its output shaft axially through the centre of the pistons and cylinders and shaft torque being produced by means of pistons acting on one or more single or double lobe cylinder cams mounted on and forming part of the shaft.

2/ An internal combustion engine having two combustion chambers, one at the outer extremity of each of the two opposed pistons each of which moves inwards and outwards in cylinders concurrently and each acting via rollers attached to an extension of each piston, on a cylinder cam located between the pistons and mounted on and forming part of the axial output shaft so as to cause rotation of the shaft when pressure is applied to the pistons.

3/ Application of a piston - cam - shaft arrangement described in claims 1 & 2 in a fluid pump (liquid or gaseous) or compressor utilizing an axial drive shaft passing through the centre of the pistons and cylinders and driven by external means.

4/ Combination compressor/ pump & internal combustion engine utilizing the piston - cam - shaft arrangements described in claims 1 & 2. Using one end i.e., piston and cylinder (claims 1 & 2), as power producing section and the opposite piston & cylinder as a fluid pump or compressor (claim 3).

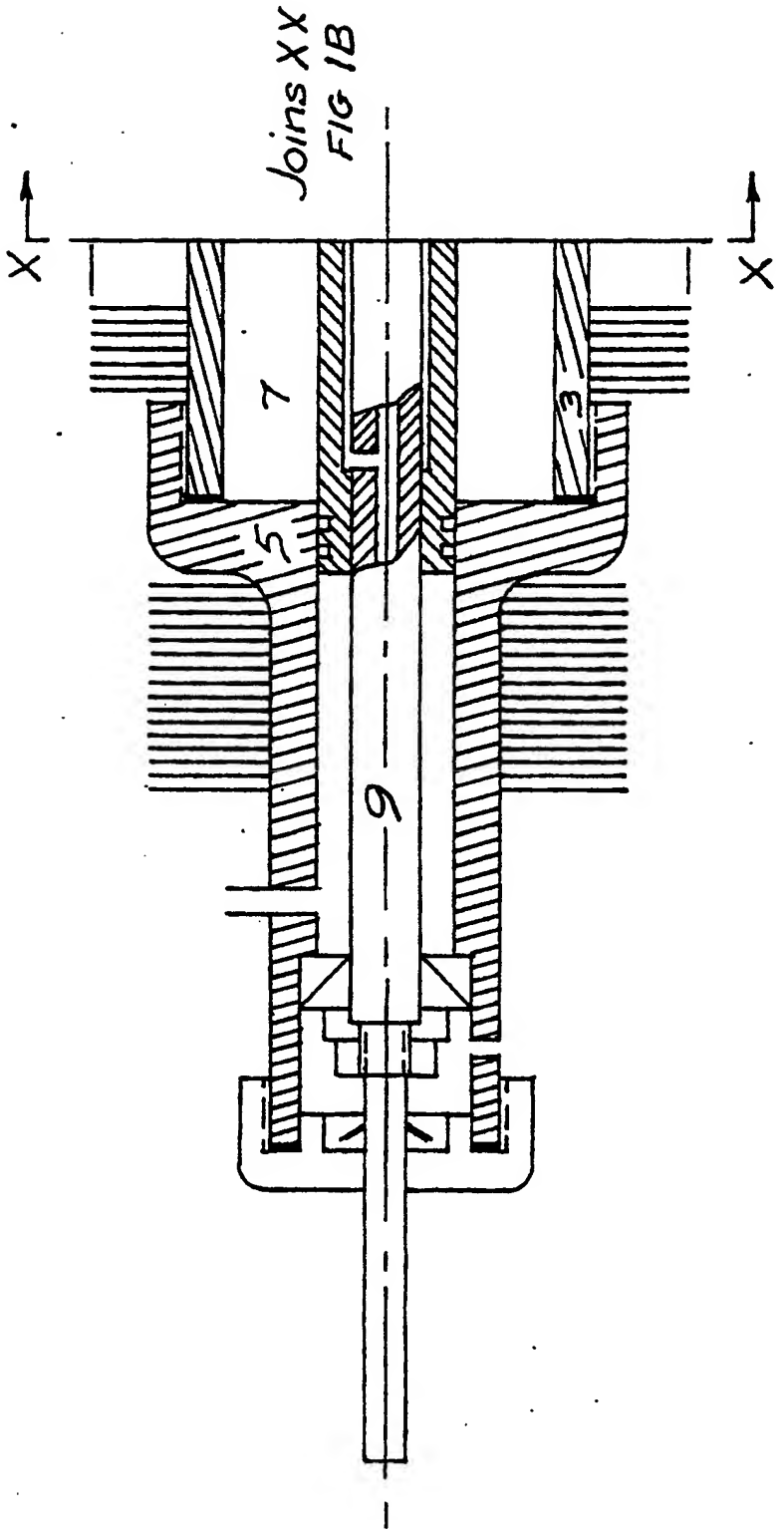


FIG 1A

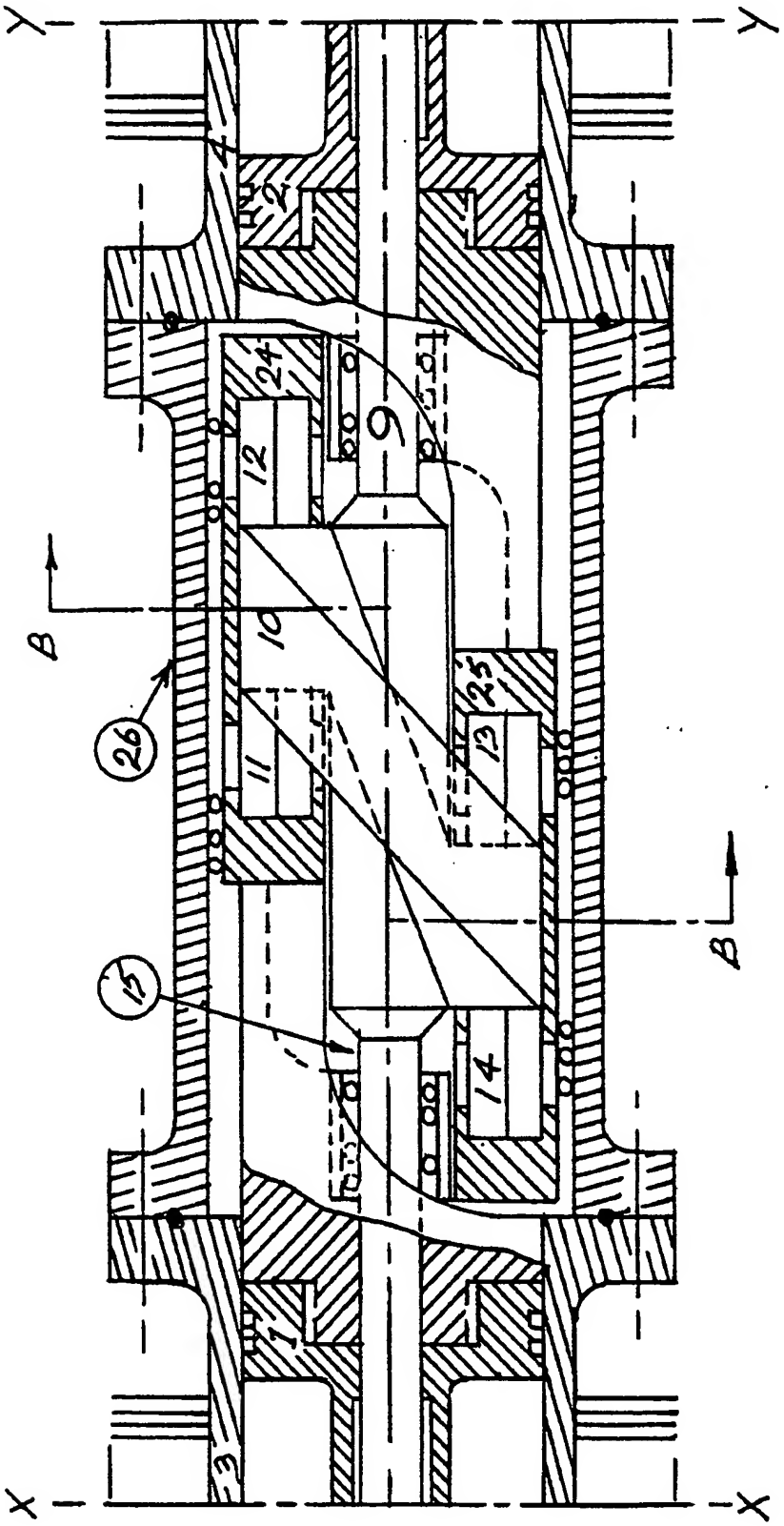


FIG 1B

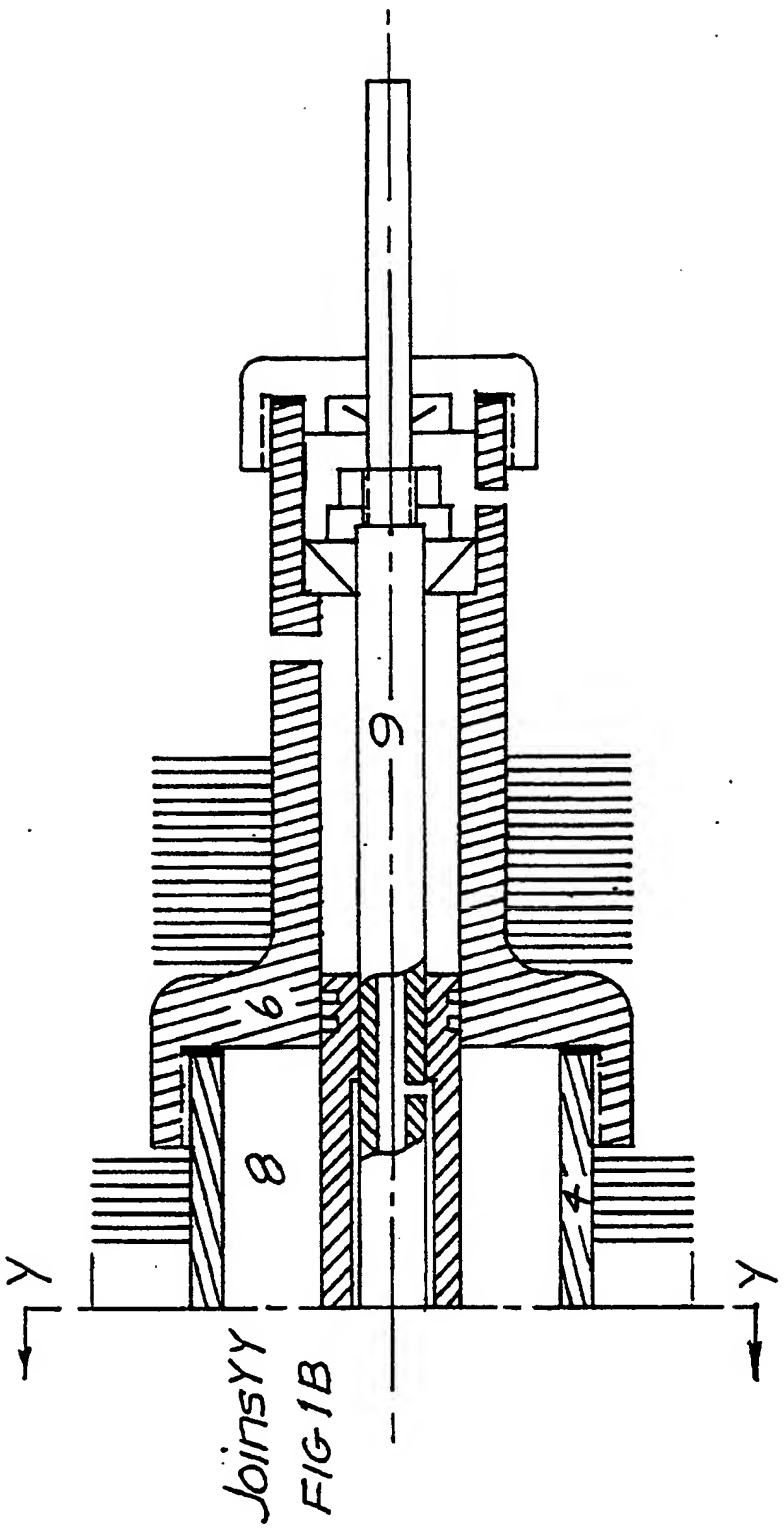


FIG 1C

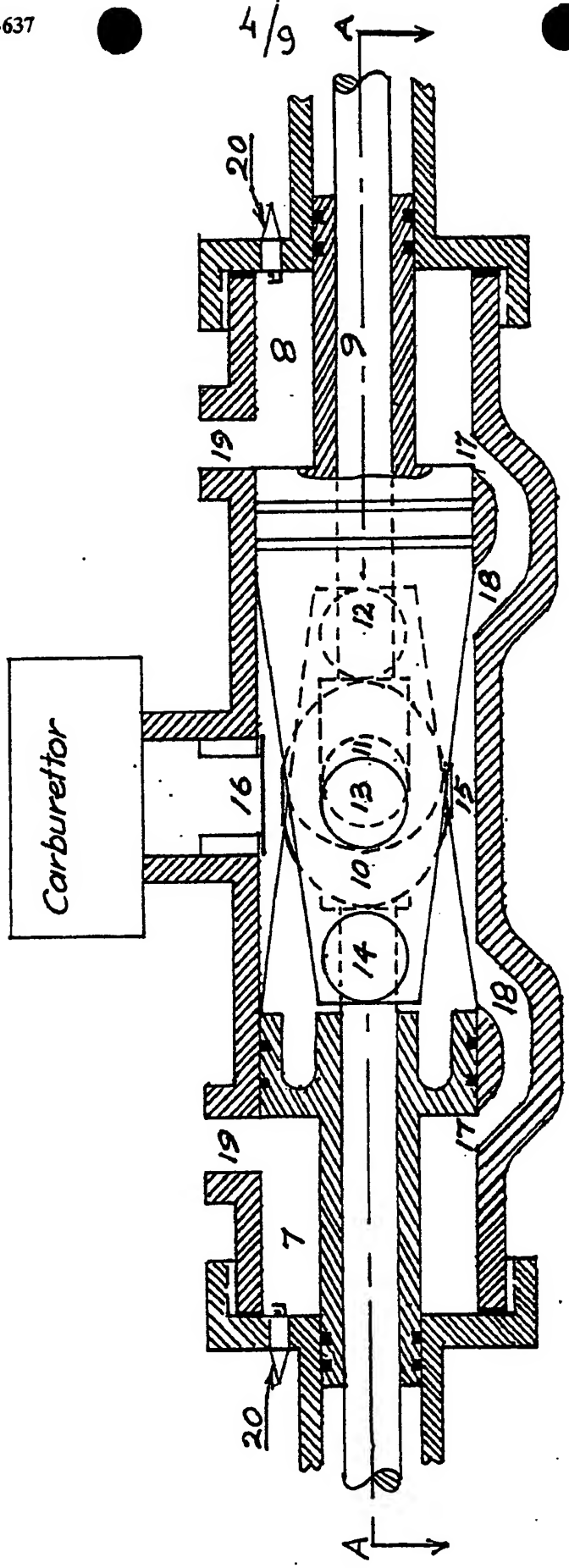


FIG 2

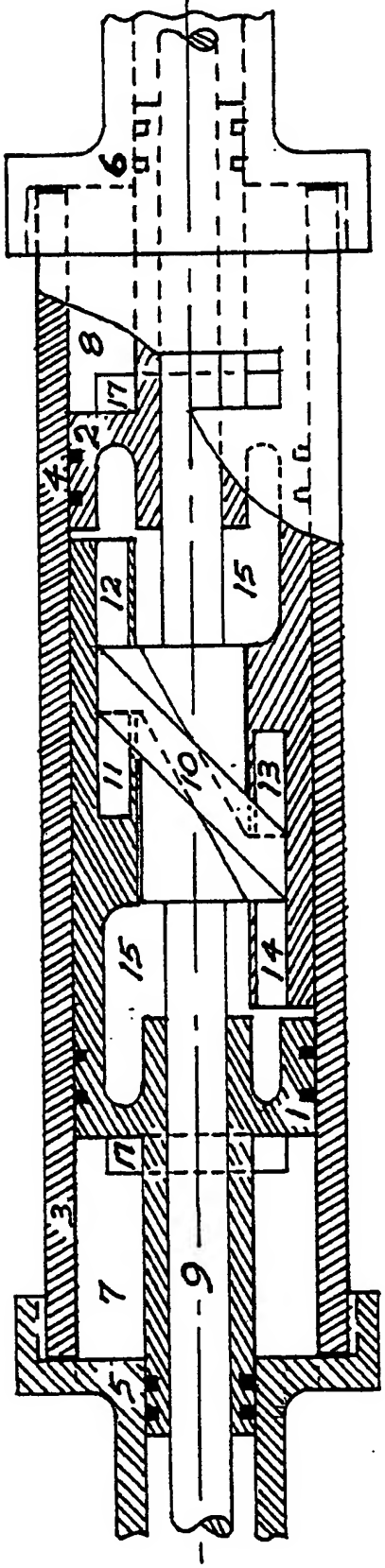


FIG. 3

SECTION ON A A (Fig 2)

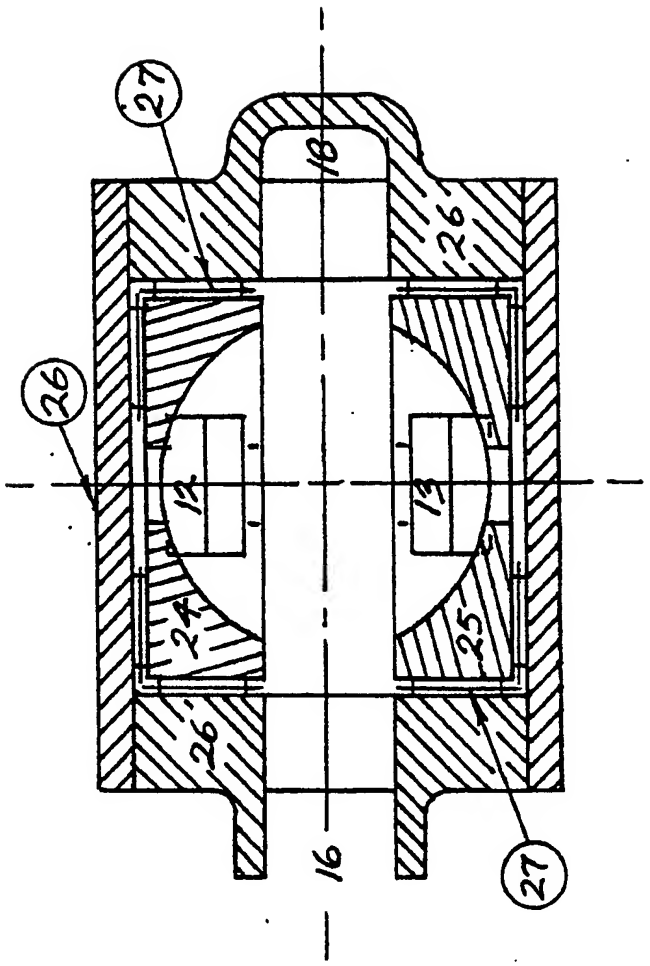


FIG 4
Section on BB FIG 1B

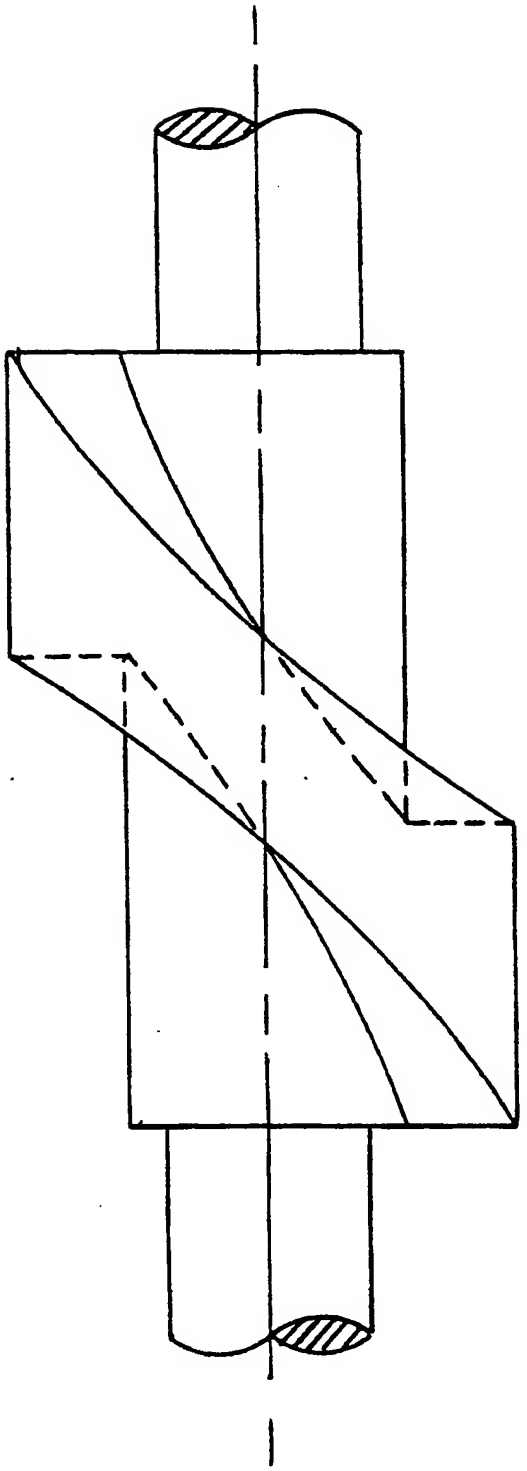


FIG 5
Two Lobe Cam (Item 10 In Specification)

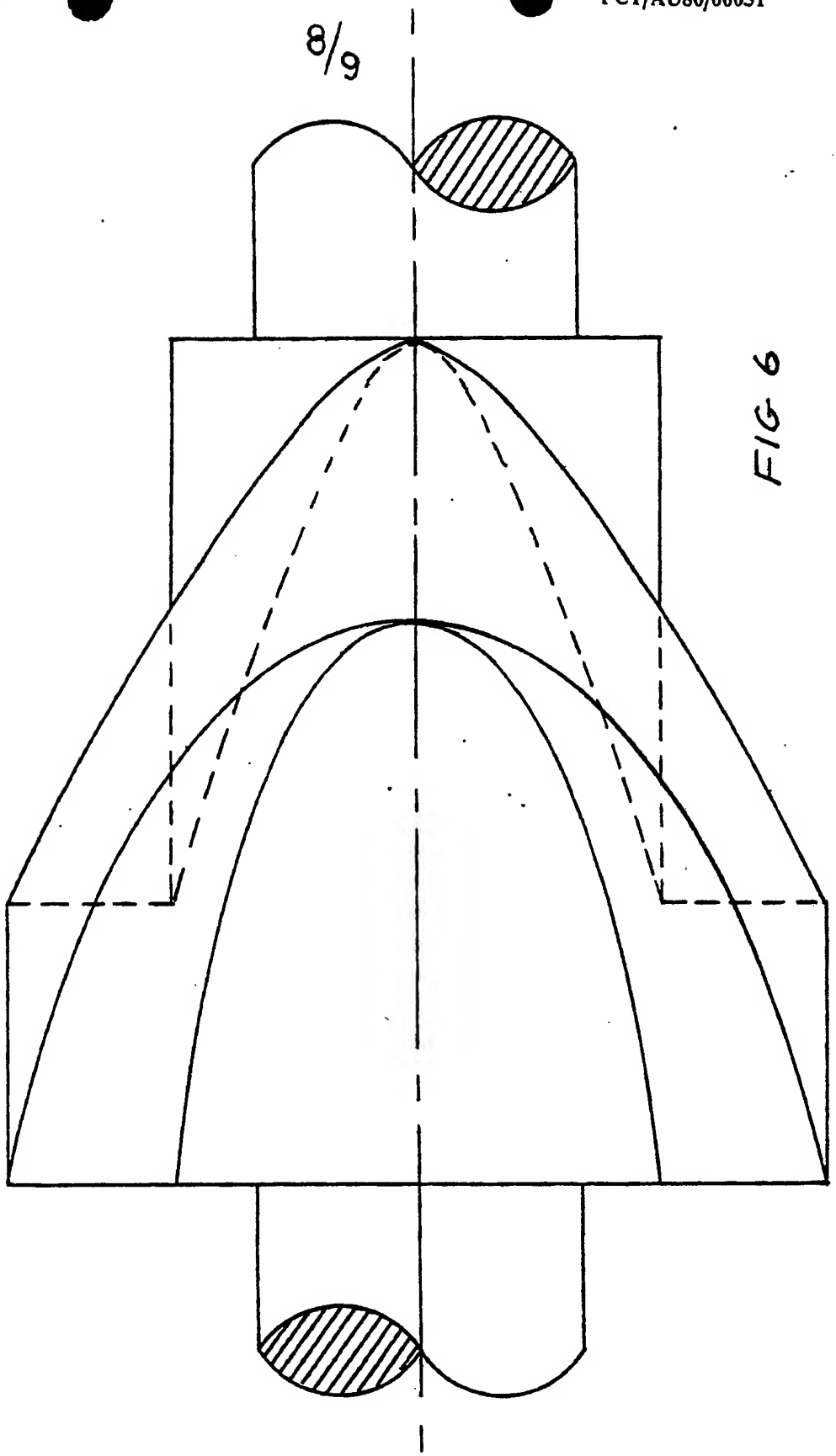


FIG 6

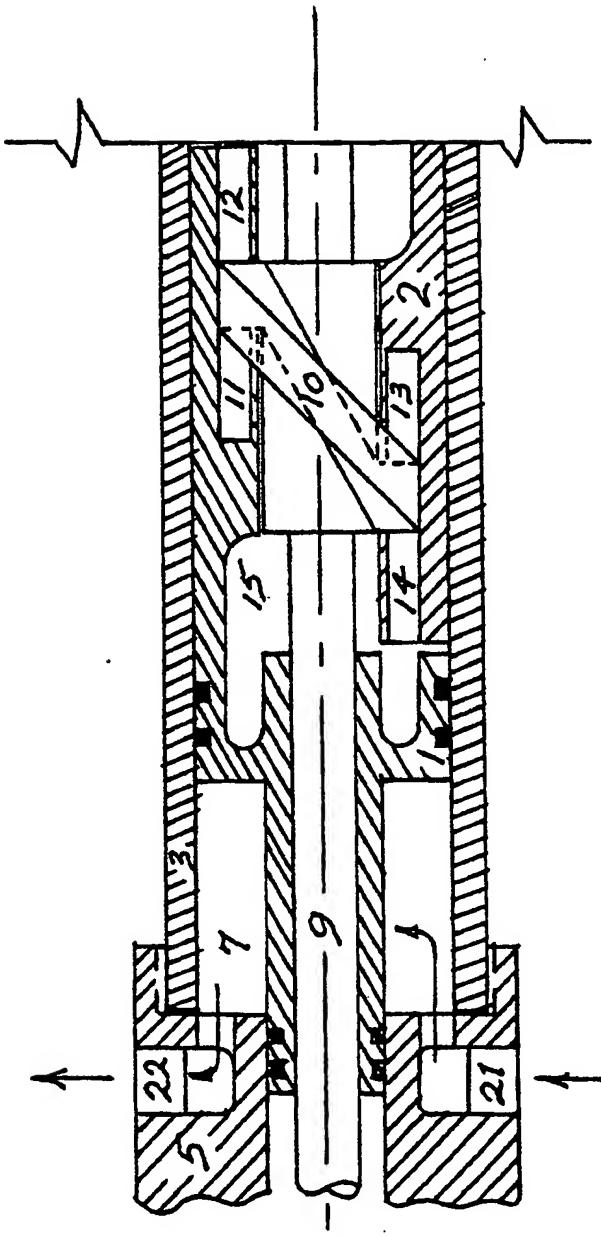


FIG 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 86/00031

I CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] F01B 3/04, 7/04, 9/06, F02B 75/26, 75/32

II FIELDS SEARCHED

Minimum Documentation Searched

Classification System	Classification Symbols
IPC	F01B 3/04, 7/04, 9/06, F02B 75/26, 75/32

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched

AU : IPC as above

III DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
X	US,A, 2347364 (PALUMBO) 25 April 1944 (25.04.44) See Fig. 3	(1-2)
X	US,A, 2316394 (BOVEE) 13 April 1943 (13.04.43) See Fig. 1	(1-2)
X	US,A, 1629686 (DREISBACH) 24 May 1927 (24.05.27) See Figs 1 and 3a-3c	(1-2)
X	GB,A, 1563498 (SCHREIBER) 26 March 1980 (26.03.80) See Figs 1-2, note item 48	(1-2)
X.	GB,A, 1450815 (PLEVYAK) 29 September 1976 (29.09.76) See Fig. 1	(1-2)
X	GB,A, 304701 (CAPDET) 24 April 1930 (24.04.30) See page 1, lines 11-21 and Figs 1-5	(1-4)
X	FR,A, 730941 (FOURNIE) 26 August 1932 (26.08.32) See Fig.1	(1-2)
X	FR,A, 652281 (COSTE) 6 March 1929 (06.03.29) See Fig.1	(1-2)
X	FR,A, 514067 (FORSBERG) 2 March 1921 (02.03.21) See Fig. 1	(1-2)

CONTINUED

* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
2 May 1986 (02.05.86)	(12-05-86) 12 MAY 1986
International Searching Authority	**Signature of Authorized Officer**
Australian Patent Office	C.M. WYATT

Form PCT/ISA/210 (second sheet) (January 1985)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

X	DE,A, 1954631 (THERMODYNAMIC SYSTEMS INC.) 6 May 1971 (06.05.71) See page 1, paragraph 1	(1-4)
X	DE,C, 513891 (LE MAITRE) 8 December 1930 (08.12.30) See Abb. 1	(1-2)
X	DE,A, 3247442 (PRACHT) 27 September 1984 (27.09.84) See Fig. 1	(1-2)

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ..... because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers ..... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers..... because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.